KEYSTONE SYSTEM RE-START PLAN

- Following Ludden, ND Pump Station Thermal Relief Valve Nipple Failure and Severance, KS Pump Station Discharge Pressure Transmitter Nipple Failure Incidents

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June 4, 2011

1 INTRODUCTION

TransCanada operates the Keystone oil pipeline system from Hardisty, Alberta to delivery terminals in Wood River and Patoka, Illinois and Cushing, Oklahoma. On May 7, 2011, the system experienced a reportable oil release of approximately 400 barrels at the Ludden, ND pump station. On May 29, 2011, a second reportable oil release of approximately 10 barrels occurred at the Severance, KS pump station.

In both cases TransCanada's Oil Control Center quickly detected the leaks through advanced monitoring systems, and in the case of Ludden, with the assistance of the public, and immediately responded by isolating the pump stations and shutting down the pipeline. All leak detection and pipeline isolation equipment functioned as designed. The released oil was mainly contained on-site and off-site environmental impacts were minimal. Clean up efforts were started immediately and finished in less than one week of the initial occurrences.

TransCanada's internal review of oil control system operating records determined that the incidents did not cause, nor were they a result of, any pipeline overpressure events.

TransCanada secured an independent materials testing laboratory to conduct mechanical and metallurgical testing in order to complete a failure analysis of the failed pipe components. These tests have been completed.

The source of the leak at the Ludden Pump Station was a 1 – inch X ¾ inch threaded swaged nipple connection on small diameter thermal relief valve piping. This piping was located on the 30" downstream pump station discharge piping in the proximity of the station Pressure Control Valve. Metallurgical analysis of the nipple identified the presence of cracks at the root of the threads believed to be the result of over torquing of the fitting during installation. High cycle fatigue due to operational vibrations propagated the cracks to failure.

The source of the leak at the Severance Pump Station was a ½ inch diameter nipple at an oil pressure transmitter manifold located on the 30" downstream pump station discharge piping in the proximity of the station pressure control valve. Metallurgical testing has indicated the cause of the failure to be high cycle fatigue due to operational vibrations. No signs of over torquing were observed on the Severance nipple.

Improper or defective materials were ruled out as contributing factors of either incident.

To ensure the safe and reliable restart of the pipeline and to prevent recurrence of similar incidents occurring on the Keystone system in the future, TransCanada has made improvements. These include replacements and modifications to the affected components at the Ludden and Severance Pump Stations and all other applicable stations along the entire length of the pipeline.

In addition to these improvements, extensive non-destructive tests (i.e. magnetic particle inspections and dye penitent inspections) were performed on station piping connections that were in proximity to the pressure control valve on every like kind pump station to ensure that these

connections were not adversely affected by the operational vibrations that contributed to the two nipple failures.

TransCanada will use a staged approach to safely restart the Keystone pipeline system which will include manned coverage at certain identified stations. Ramping up the flows on the system in stages will allow for a gradual increase in the load on the pipeline system. This conservative approach will allow the system time to gradually warm up, as well as providing an opportunity to confirm the effectiveness of the repairs and assess operational vibration levels prior to proceeding to each subsequent flow rate stage.

Once the pipeline has been returned to service additional modifications are planned to further reduce the probability of recurrent incidents. In addition, an extensive third party vibration study has been commissioned that will determine the root cause of the operational vibrations being experienced, identify the long term effects of these vibrations and recommend further corrective actions if required.

Subject to the Office of Pipeline Safety's review and approval of this Restart Plan and the corrective actions taken to date, TransCanada will be ready to commence restart operations during daylight hours only on Sunday, June 5, 2011.

2 FAILURE CAUSES

The failed materials were secured at site and transferred to a Materials Testing firm located in Houston, Texas, who then prepared failure investigation reports on both failures at the request of TransCanada. The primary cause of the failed fittings at the Ludden and Severance pump stations was vibration induced high cycle fatigue, with the Ludden fitting failure being initiated by an over torquing event. The testing did not identify faulty materials. The test reports have been provided to PHMSA and any future updates or revisions will be sent simultaneously to PHMSA and TransCanada.

The principle source of the vibration at the pump stations has been identified as the control valve located on the discharge piping of each pump station and used to control station output pressure. This pressure control valve (PCV) opens and closes incrementally to reduce throughput and control the station output pressure. TransCanada's investigation and analysis has concluded that the level of vibration from this valve increases as the valve is closed under high flow conditions.

Both the Ludden and Severance pump stations use fixed speed drives that require the utilization of the PCV to ensure that the Maximum Operating Pressure of the pipeline is not exceeded. TransCanada has analyzed the historic use of the PCV at fixed speed stations and has determined it as the primary factor for prioritizing modifications at these fix speed pump stations.

Some Keystone pump stations utilize electric motors which can vary their output speed through the use of a variable frequency drive (VFD). These VFD equipped stations can modulate the station output pressure without the use of the PCV. In these stations the PCV is used very little to reduce pressure and therefore have not created high vibration conditions.

Field operations staff has also reported higher levels of operational vibrations at the fixed speed stations and minimal vibrations at VFD stations. The scope of modifications or replacements was directed by the conclusion that the high operational vibration levels associated with high cycle fatigue were principally present at fixed speed stations. This conclusion is supported by the PCV utilization histograms Vibration readings will be collected at a representative VFD station during initial startup to verify this conclusion.

TransCanada's has reviewed its station level control systems and concluded that variations in the control system logic are not a contributor to these incidents. The pressure control logic at all VFD stations is the same and the pressure control logic at all PCV only stations is the same. Tuning parameters are the only differences from station to station. Tuning parameters were first established through modeling and then adjusted during initial on site commissioning. Further tuning was performed as line rates increased in January & February of 2011. We have release notes associated with the changes. The differences are not related to the control valve logic, so from a control valve logic perspective, all sites are the same.

3 EQUIPMENT MODIFICATIONS, REPLACEMENTS AND INSPECTIONS

3.1 The following actions were taken as a result of the Ludden incident at all VFD and fixed speed stations due to the possibility of over torque installation at any site:

- All schedule 80 swage nipples used on the thermal relief valves were replaced with schedule 160 fittings. The schedule 160 fitting is a thicker walled material which helps to minimize the effect of operational vibrations and reduces the susceptibility to over torquing during installation. Instructions were provided to installation crews on how to complete the installation of new nipples to avoid over torque installations.

- Bracing was installed on the thermal relief valve piping assemblies at every VFD and fixed speed station. The bracing minimizes the levels of operational vibrations on the susceptible fitting and other joints on the piping assembly. The second generation bracing will be installed at those fixed speed pump stations where the first generation bracing does not adequately reduce the vibration levels as determined through ongoing vibration measurement.

3.2 The following actions were taken as a result of the Severance incident:

At all fixed speed stations the three transmitters located in close proximity to the PCV have been relocated off the 30 inch piping, mounted on a separate support structure and connected via ½ inch stainless tubing. This modification results in the replacement of the nipple which failed as well as significantly reducing the stress on this joint created from the vibration.

Replacement of Nipple
At all fixed speed stations the threaded nipples on the remaining pressure transmitter assemblies in the station (will be replaced. This removes the existing nipple that may have suffered fatigue damage in order to ensure continued safe operation until these transmitters can also be off mounted in a similar fashion to the 3 pressure transmitters located on the discharge piping after initial start up. The replacement of these fittings will zero base the fitting from a fatigue cycle perspective. Also field observations confirm that vibration levels are much less the further away the piping is from the PCV location.

NDE Inspections at Fixed Speed Pump Stations
As an added precaution, a select number of welds on small inch branch connections off the discharge piping in proximity to the PCV were NDE inspected for surface breaking features. All of the completed field NDE inspections revealed no evidence of cracking.

Similarly, NDE inspection was also be completed on the welded connection on the instrument valve manifold where it connects to the blind flange. Additionally, this welded connection on the manifold associated with the failed fitting was inspected with dye penetrant at the lab as well as sectioned. No cracking or other defects were revealed that would indicate a diminished weakness to the joint.

NDE Inspections at VFD Pumps Prior to that Station Re-Starting
As an added level of precaution it was deemed prudent to perform inspections on a sample of similar nipple fittings from VFD pump stations. Three nipples from VFD stations were removed and inspected and no evidence of cracking was found. The vibration test data has been provided to PHMSA.

4 PIPELINE SYSTEM RE-START PLAN

TransCanada will use a staged approach to gradually ramp up flow and increase load on the pipeline system. This staged approach will limit the use of PCV to control flows and thereby reduce vibration levels. This approach increases safety and allows the system time to gradually warm up. As well this will provide an opportunity to monitor and confirm the effectiveness of the repairs prior to proceeding to each subsequent flow rate. Each stage will have a target flow rate and a short term maximum flow rate which will not be exceeded. The local emergency response officials have been contacted to inform them of the intended restart of the pipeline.

In the first stage, 5 fixed speed stations will be operated in the US with the 3 remaining fixed speed stations coming into operation in Stage 2 and remaining online in stage 3. All operating, fixed speed stations will be manned for a minimum of 8 hrs per day commencing on the first day

of restart and for 4 days of stage 3 operations. The purpose for manning only the fixed speed stations is due to the conclusion that operational vibrations of concern are isolated to these types of station configurations. However, the VFD station at Steele City will be operated in all three stages and will be manned to verify these assumptions. While on site the operations personnel will monitor for abnormal operating conditions and assist with gathering vibration related data. This will ensure that the equipment modifications implemented to prevent recurrence are effective.

Prior to moving to each subsequent flow rate stage, we will achieve stable operation at the target flow rate. Each flow rate stage increase will occur during daylight hours. Status reports will be completed and verified by a corporate officer for each flow rate stage before proceeding to the next stage. A copy of this report will be sent to PHMSA.

Vibration Data Gathering During Restart

On site vibration monitoring by will begin on the first day of restart to ensure that the addition of relief valve bracing has been effective and that vibration levels across the fixed speed station piping is assessed. This data gathering is intended to identify any undiagnosed issues associated with elevated vibration conditions and help in further increasing the factor of safety at these locations.

Vibration data gathering activities during start up:

1. Prioritization of sites for continuous monitoring is based upon utilization rates, magnitude of pressure differential across the PCV at fixed speed pumps sites and historical baseline data. This analysis led to the selection of the following priority station; Severance, Freeman, and Fort Ransom (in the US) and Lakesend (in Canada). Vibration signatures will be captured when vibration reaches a threshold level. Pressure control valve position will be captured simultaneously.

2. Additionally, all fixed speed pump sites will have discrete data gathering performed at each phase of the start-up at numerous, identified, susceptible locations within each station. This will begin at pipeline start-up and continue until sufficient data is gathered at high through put levels. Escalation set-points will be developed to facilitate prompt and appropriate actions will be taken upon discovery. Discrete data gathering will be completed within 30 days at VFD pump stations once high flows have been reached.